Iceberg Catalog as a Service

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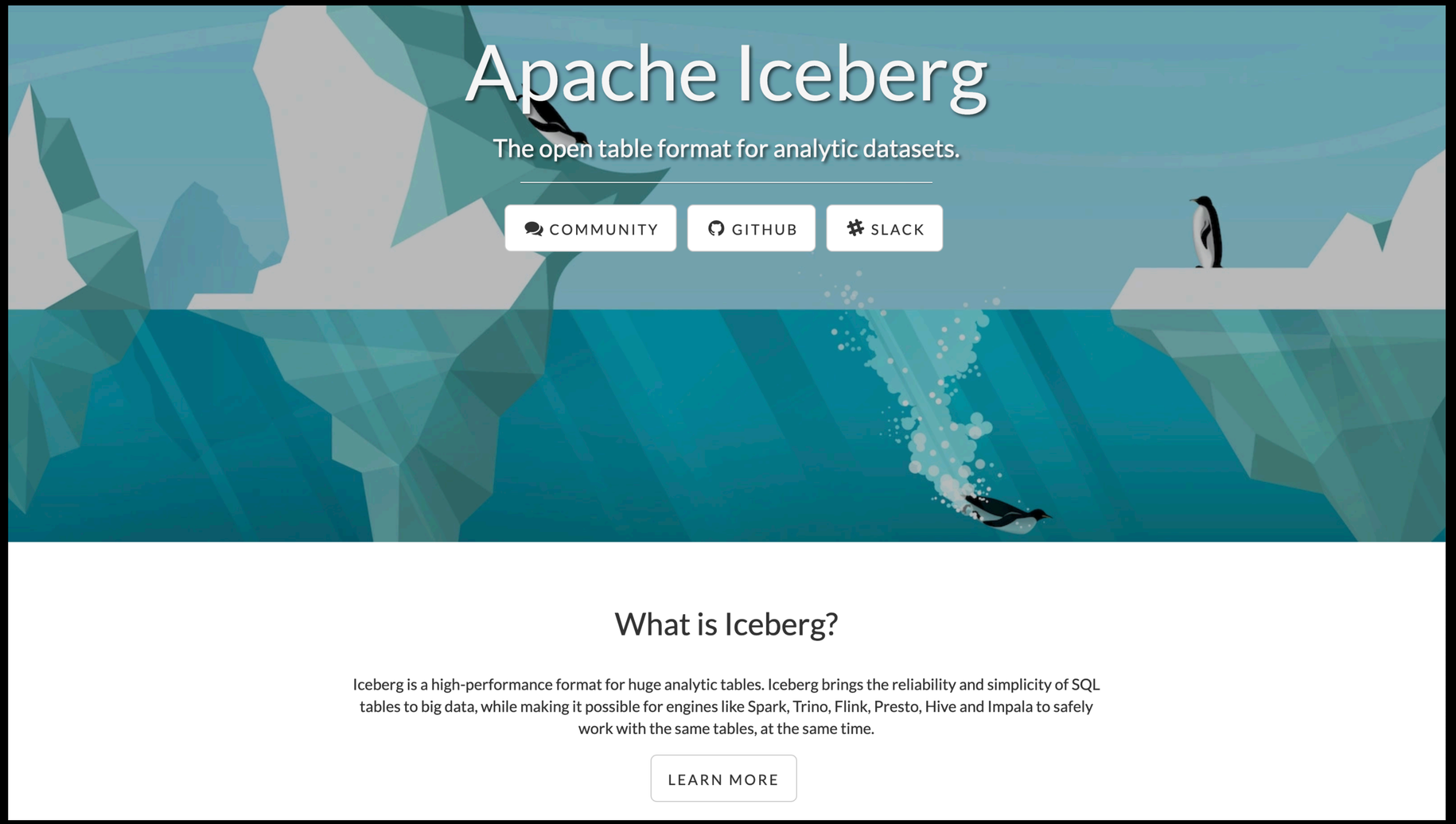
CommunityOverCode | Oct 9th, 2023

NOT A CONTRIBUTION

Agenda

- Apache Iceberg and Catalogs
- History of Hive Metastore
- REST Catalog Highlights
- Choosing the Right Catalog

Apache Iceberg



Catalog

Where are all my tables ?

How can I access them (safely) ?

Catalogs Supported in Apache Iceberg

Popular Choice

- HiveCatalog (incubation/2018)
- HadoopCatalog (Nov 2019)
- JDBCCatalog (June 2021)
- RESTCatalog (May 2022)

With Vendor Support

- GlueCatalog
- SnowflakeCatalog
- You can even build your own catalog

History of Hive Metastore

- Apache Hive was introduced as warehousing solution over map-reduce framework back in VLDB 2009
- Hive metastore was included as a system catalog from Hive project, used to keep track metadata of tables, such as schema, key-value properties and ownership.
- Most Iceberg users migrated from Hive, can reuse the same hive metastore for catalogue

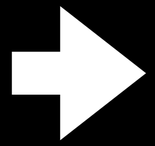
https://www.vldb.org/pvldb/vol2/vldb09-938.pdf

Hive Locking Problem

Iceberg Table

Commit

to HiveCatalog



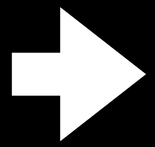
1. Lock Table
2. Get Table
3. Alter Table
4. Unlock Table

Hive Locking Problem

Iceberg Table

Commit

to HiveCatalog



1. Lock Table
2. Get Table
3. Alter Table
4. Unlock Table

```
WARN Tasks: Retrying task after failure: Waiting for lock.

org.apache.iceberg.hive.HiveTableOperations$WaitingForLockException: Waiting for lock.
Caused by: org.apache.iceberg.exceptions.CommitFailedException:
Timed out after 182592 ms waiting for lock on namespace.table
```

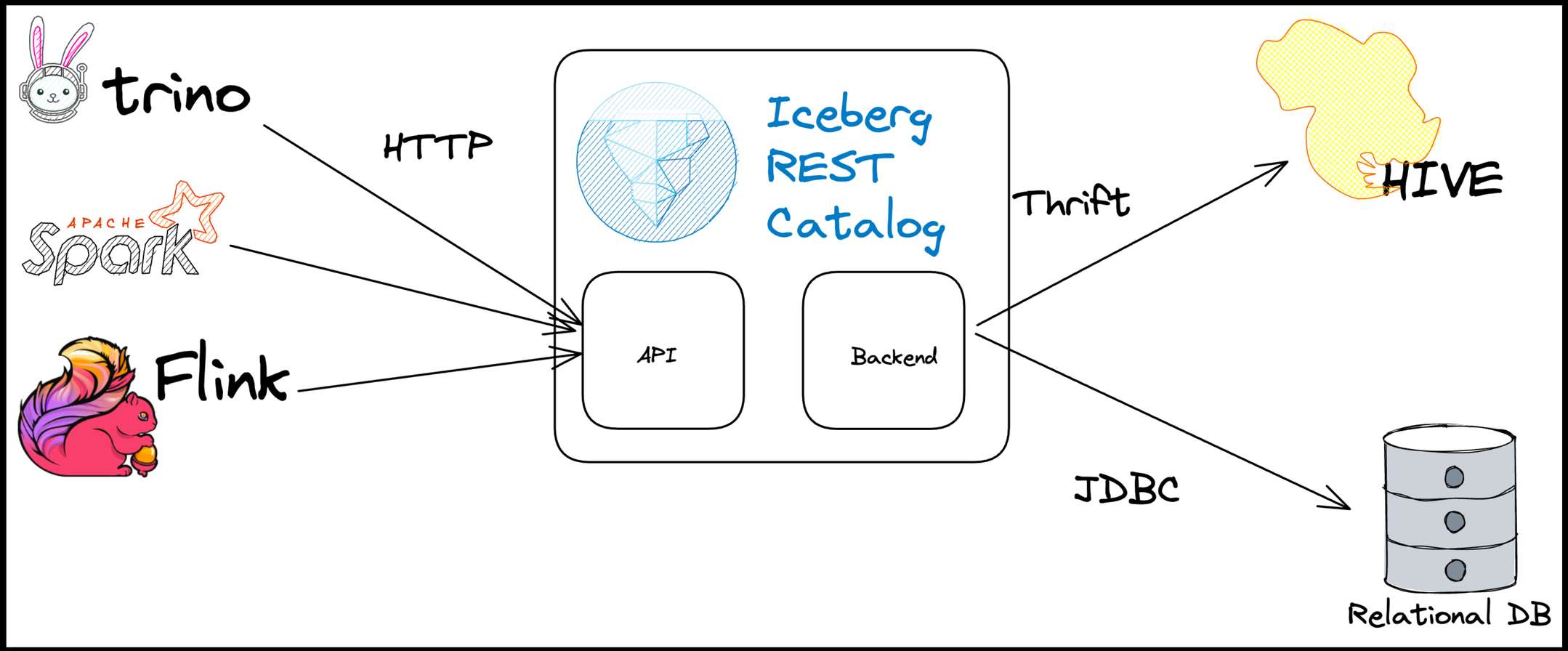
Path to Lock Free

Lock-free implementation iff

- Upgrade Hive metastore server with fix HIVE-26882
- Upgrade all Iceberg library in engines to 1.3
- All engines need to disable Hive locks on commit
- 🔥 Risk of corrupting table if handled incorrectly

https://github.com/apache/iceberg/pull/6570

REST Catalog Highlights



We can solve any problem by introducing an extra level of indirection
- Andrew Koenig

Iceberg REST Catalog APIs

```
//Namespaces API
POST    /v1/{prefix}/namespaces
GET     /v1/{prefix}/namespaces
GET     /v1/{prefix}/namespaces/{ns}
POST    /v1/{prefix}/namespaces/{ns}/properties
DELETE  /v1/{prefix}/namespaces/{ns}

//Configuration API
GET     /v1/config

//Authorization API
POST    /v1/oauth/tokens
```

Iceberg REST Catalog APIs

```
//Tables API
POST    /v1/{prefix}/namespaces/{ns}/tables
POST    /v1/{prefix}/namespaces/{ns}/register
GET     /v1/{prefix}/namespaces/{ns}/tables/
GET     /v1/{prefix}/namespaces/{ns}/tables/{tbl}
POST    /v1/{prefix}/namespaces/{ns}/tables/{tbl}
DELETE  /v1/{prefix}/namespaces/{ns}/tables/{tbl}
HEAD    /v1/{prefix}/namespaces/{ns}/tables/{tbl}
POST    /v1/{prefix}/tables/renames

//Metrics API
POST /v1/{prefix}/namespaces/{ns}/tables/{tbl}/metrics
```

Choosing the Right Catalog

Language agnostic implementation

Pluggable access control

Aggregated metrics report

Support of Hive Tables

Iceberg Commit Metrics

```
insert into
iceberg.foo.bar
values (…)
```

```
POST /v1/prefix/namespaces/foo/tables/bar/metrics

table-name: iceberg.foo.bar

operation: append

metrics:

  added-data-files: {unit: count, value: 5}

  added-files-size-bytes: {unit: bytes, value: 3323}

  added-records: {unit: count, value: 5}

  attempts: {unit: count, value: 1}

  ...

  total-duration: {count: 1, time-unit: nanoseconds,
total-duration: 270419834}

metadata: {app-id: local-1695675112222, engine-name:
spark, engine-version: 3.3.3,
```

Iceberg Scan Metrics

```
select * from
iceberg.foo.bar
where id >= 3

+---+----+
| id|data|
+---+----+
|  3| 3.0|
|  4| 4.0|
|  5| 5.0|
+---+----+
```

```
POST /v1/prefix/namespaces/foo/tables/bar/metrics

table-name: iceberg.foo.bar

filter: {term: id, type: gt-eq, value: (1-digit-int)}

metrics:

  result-data-files: {unit: count, value: 3}

  scanned-data-manifests: {unit: count, value: 1}

  skipped-data-files: {unit: count, value: 2}

  skipped-data-manifests: {unit: count, value: 0}

  ...

  total-planning-duration: {count: 1, time-unit:
nanoseconds, total-duration: 37548625}

metadata: {app-id: local-1695675112222, engine-name:
spark, engine-version: 3.3.3,
```

Migrate Catalog

Delegate

Set up REST catalog endpoints and delegate all requests to original HiveCatalog

Switch

Update engine configuration (Spark/ Flink/Trino) so it connects to REST instead of Hive

Migrate Backend

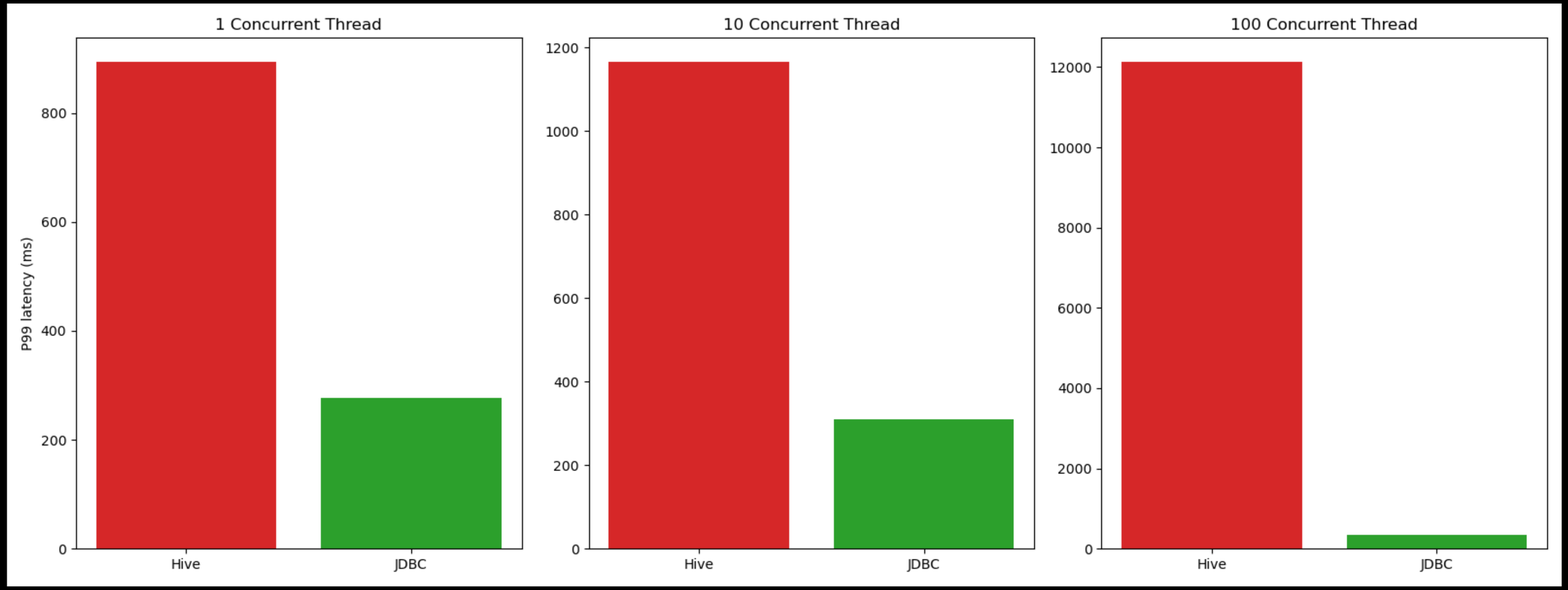
Prepare

Provision new relational database for JDBC backend and restrict network access

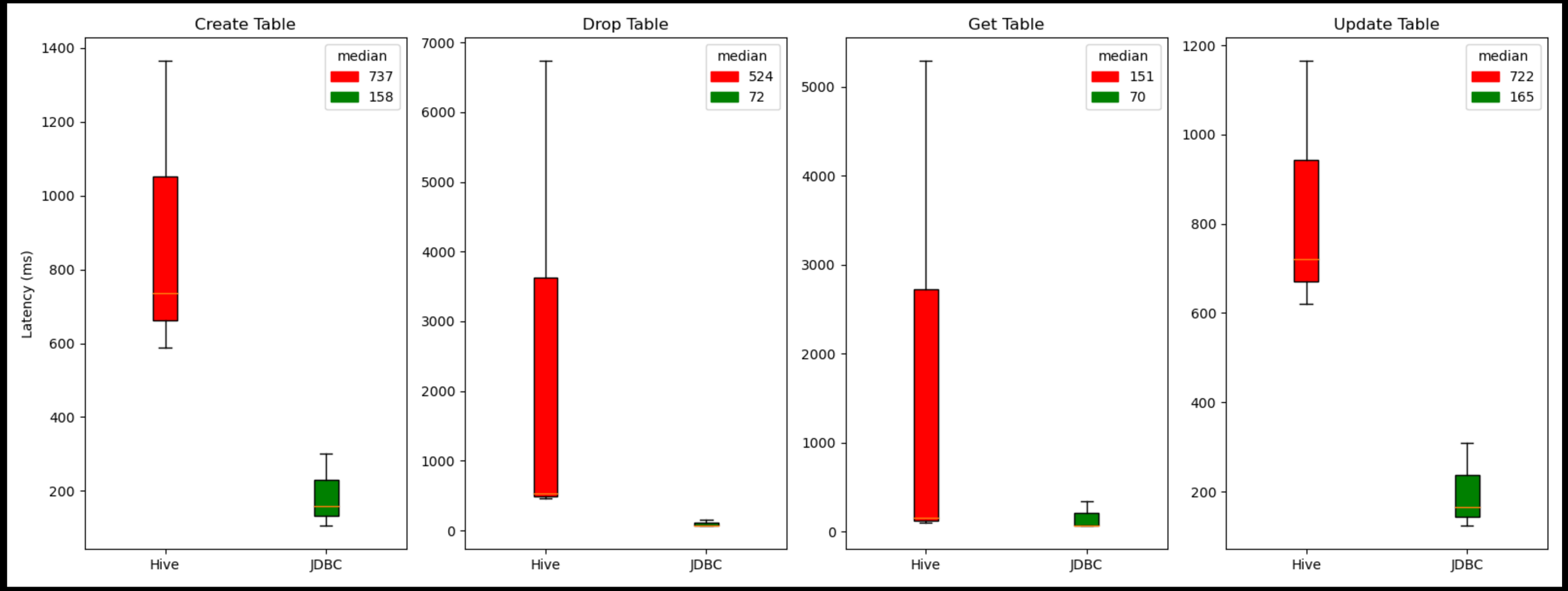
Migrate

Leverage register-table API to migrate Iceberg tables from Hive to JDBC backend

Performance Under Load



Performance Breakdown by API



Benchmark Setup

- Server
  - 2 REST endpoints on Kubernetes
  - 3 pods, 1 core and 4GiB memory for each
- Dependencies
  - Iceberg 1.2.1
  - Hive metastore 3.1
  - PostgreSQL 15
- Clients
  - Apache JMeter to simulate client requests

Contribute Back to Community

- OpenAPI: Add namespaceExist API: #8569
- Core: Extend ResolvingFileIO to support BulkOperations: #7976
- Build: Add openapi label: #7721
- OpenAPI: TableRequirement definition and parser mismatch: #7700
- Core: Fix SetDefaultPartitionSpec to use specId instead of schemaId #7350
- OpenAPI: Return 204 on no content response #7229
- OpenAPI: Correct snapshot id and time ms int format #6921

Thanks For Attending

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@dramaticlly